

OCTOBER 2019



**WIM #32
US 52, MP 66.0
ORONOCO, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #32 is located on US 52 near Oronoco in Olmsted county.

System Operation

WIM #32 was operational for the entire month of October 2019. Volume was computed using all monthly data.

System Calibration

WIM #32 was most recently calibrated on 2019-06-06. Table 1 summarizes the front axle weights of class 9s by lane ¹. Figure 1 shows the distribution of gross vehicle weights (GVW) in Class 9 vehicles at this site for the last 12 months of operation ². Figure 2 depicts the average front axle weight as a percent difference from the first full month following calibration.

Summary of Volume Statistics

Total Monthly Volume: 1014552 | Passenger Vehicles: 930636 | Heavy Commercial Vehicles: 83916

Monthly Average Daily Traffic (MADT): 32808 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 2707

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. NB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Tuesdays. SB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Tuesdays (see Figure 3 and 4).

Passenger Vehicles (PVs)

Volume trends. On an average 24-hour day (see Figure 5), NB PVs generally reached peak volume levels between 03 PM and 05 PM. Similarly, SB PVs peaked in volume between 03 PM and 05 PM

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling NB typically reached peak volume levels between 03 PM and 05 PM, while volume going SB peaked between 03 PM and 05 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 9's and Class 5's.

Overweight HCVs

Volume trends. Of a total of 83916 HCVs, 13664 of them were overweight ³. These overweight HCVs contributed to 1% of total monthly volume, and 11.8% of total monthly

HCV volume. NB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Sundays. SB overweight vehicles tended to reach highest volumes on Mondays, with lowest volumes reported on Saturdays. See Figure 3 .

The top two overweight violators by class were the class 9 and class 10 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 68.4% of all overweight vehicles traveling NB this month (see Figure 7 & 8). Figure 9 shows the number of vehicles exceeding 88,000 pounds that crossed the WIM over the last 12 months. The highest number of 88,000+ vehicles within the last 12 months occurred in June.

WIMs are currently used as a screening tool for weight enforcement, and it is estimated that the WIM scales can measure gross vehicle weights (GVW) within 90-95% of static weight scale measurements. Due to the possibility of measurement error, vehicles exceeding 10% of their legal weight limits (or 1.1 times their legal weight limits) are considered overweight in this report ⁴.

Using normal load limits ,362 NB vehicles exceeded 88,000 pounds (155 vehicles were Class 9's; 107 vehicles were Class 13's). Of vehicles traveling SB,

212 NB vehicles exceeded 88,000 pounds (89 vehicles were Class 9's; 61 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from October 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in October 2019. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling NB, while there were more fully_loaded Class 9's than empty traveling SB. Data also suggests that there were more fully_loaded Class 10's than empty traveling in the NB direction. In the SB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 994124 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (56.2%) than SB (43.8%). See Table 4 and Figure 11 for more freight information.

####Infrastructure Considerations Bridge. Bridge No. 55X13 (a box culvert) is approximately 1/3 of a mile north of WIM #32, and Bridge No. 8960 (a box culvert) is approximately 1 ¾ miles south of WIM #32. WIM #32 recorded a total of 1014552 vehicles with a combined GVW of 10648128 kips (1 kip = 1,000 pounds = 0.5 tons) in October 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 88604 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 57.6% of all ESALs were recorded NB while 42.4% was observed SB. In particular, 77% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 35% of total GVW observed this month). See Table 6 and Figures 14-15 for more information on ESALs (Table 6 also provides flexible ESAL factors for each vehicle class using a terminal serviceability of 2.5 and a structural number of 5).

#####WIM monthly reports can be found at:

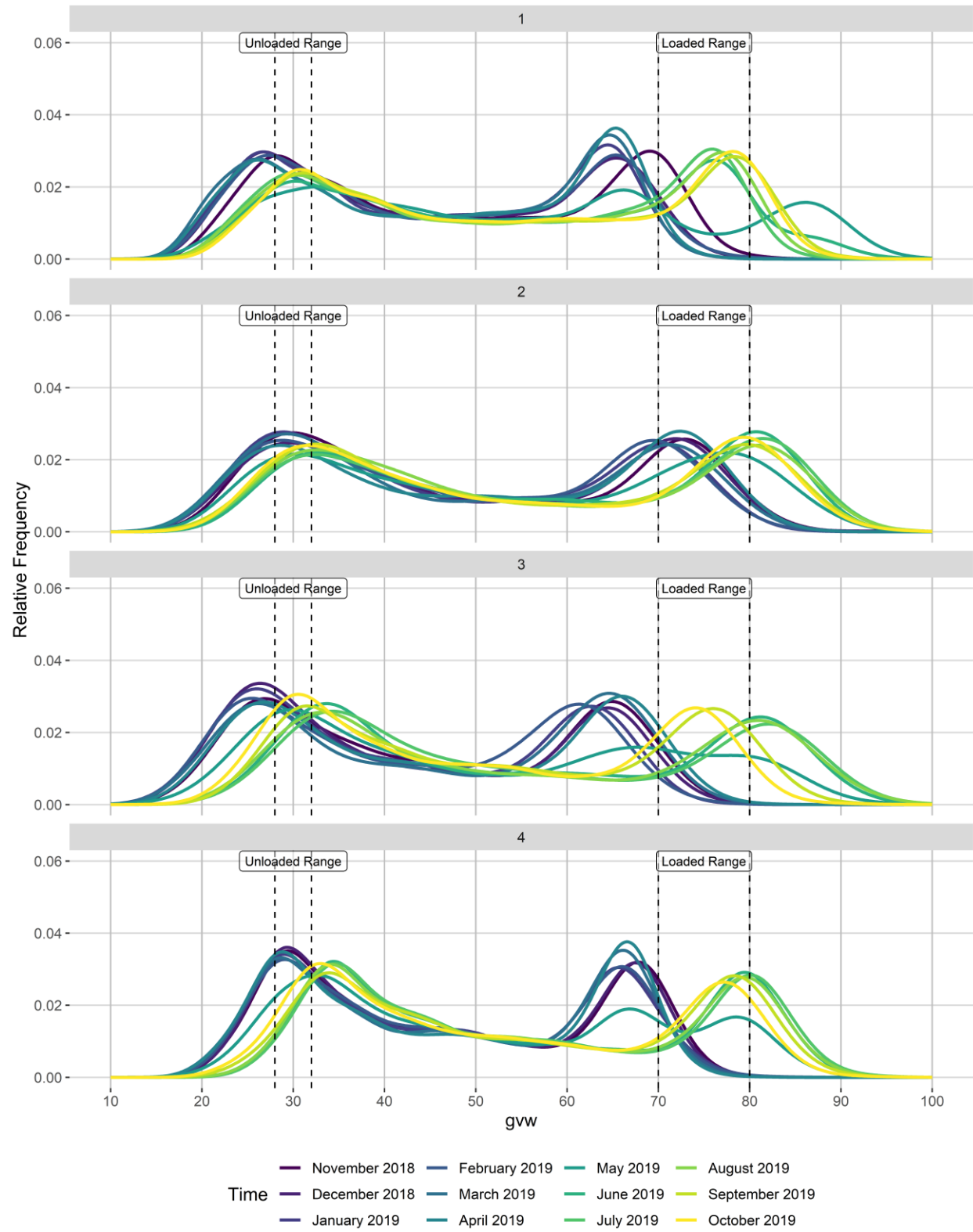
<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle

classification scheme and vehicle class groupings for traffic forecasting can be found at:
<http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to have each individual axle weight stay within a range of ±9% of baseline calibration values
- ² Previous WIM research indicates that unloaded Class 9s typically weigh 28-32 kips, while loaded Class 9s generally fall in the 70-80 kip range. More recent data from several WIM sites suggests that the unloaded Class 9 range may have moved a little higher over time (due to increased presence of sleeper cabs, etc.), although these ranges are also thought to be site-specific.
- ³ An HCV is considered overweight during normal load limits in this report if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 80,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 20,000 pounds; tandem axles spaced 8' or less = 34,000 pounds; tridem axles spaced 9' or less = 43,000 pounds; quad axles spaced 13' or less = 51,000 pounds). Monthly reports use this standard regardless of the time of year however, the Winter Load Increase (WLI) allows a 10% across the board increase in axle and gross vehicle weights without a permit on US, state routes, and county roads. An HCV is considered overweight during Winter Load Increase(WLI) if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 88,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 22,000 pounds; tandem axles spaced 8' or less = 37,400 pounds; tridem axles spaced 9' or less = 47,300 pounds; quad axles spaced 13' or less = 56,100 pounds). An overweight HCV is only included once in the overweight volume calculations regardless of how many of the aforementioned conditions are violated. For information on MN weight limit dates and statutes:
http://www.mrr.dot.state.mn.us/research/seasonal_load_limits/sllindex.asp
- ⁴ For example, Class 9s and 10s can legally have gross vehicle weights up to 80,000 lbs (with the exception of permitted loads) during normal load limits. To account for measurement error on the WIM scales, those exceeding 10% of the legal GVW maximum (or 1.1 times the legal GVW) should be screened (e.g., 80,000 lbs + 8,000 lbs = 88,000 lbs). Similarly during WLI vehicles weighing 96,800 lbs should be screened.

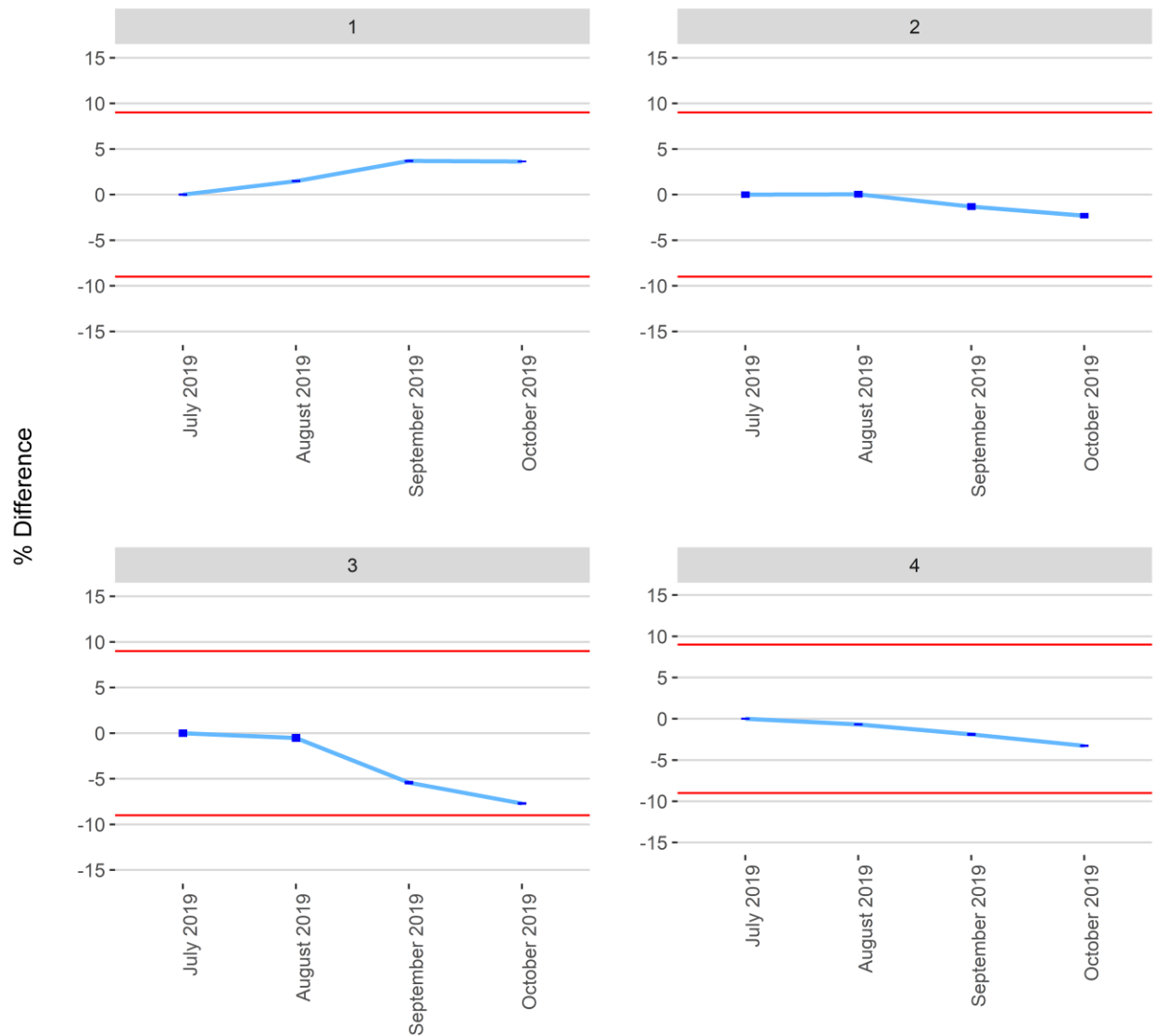
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

Figure 1 - Monthly Class 9 GVW Histogram



Months that have not passed QC parameters are not displayed

Figure 2 - Percent Difference of Front Axle Weight from Last Calibration (+/- 95% CI)



Months that have not passed QC parameters are not displayed

Figure 2 - Average Vehicle Volume
vs. Day of the Week

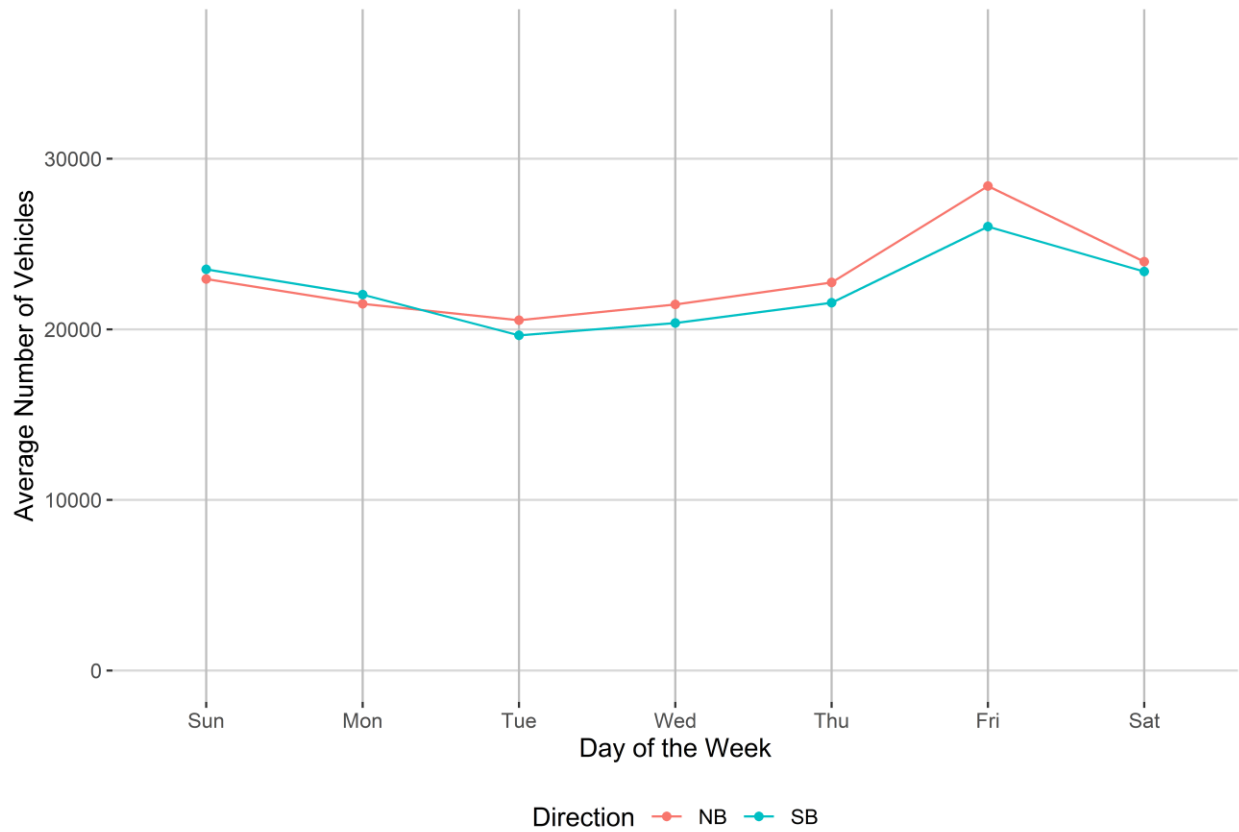


Figure 3 - Average Overweight Vehicle Volume
vs. Day of the Week

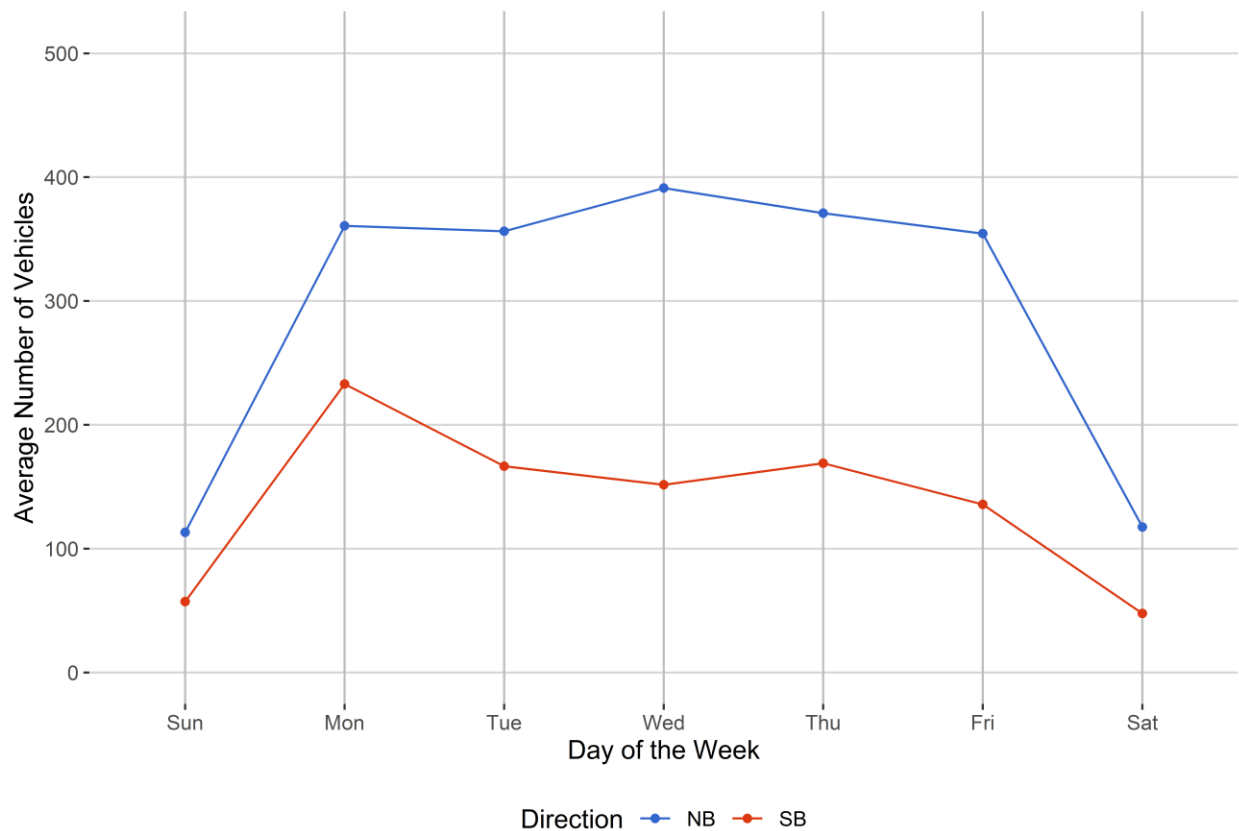


Figure 4 - Passenger Vehicles
vs. Hour of the Day

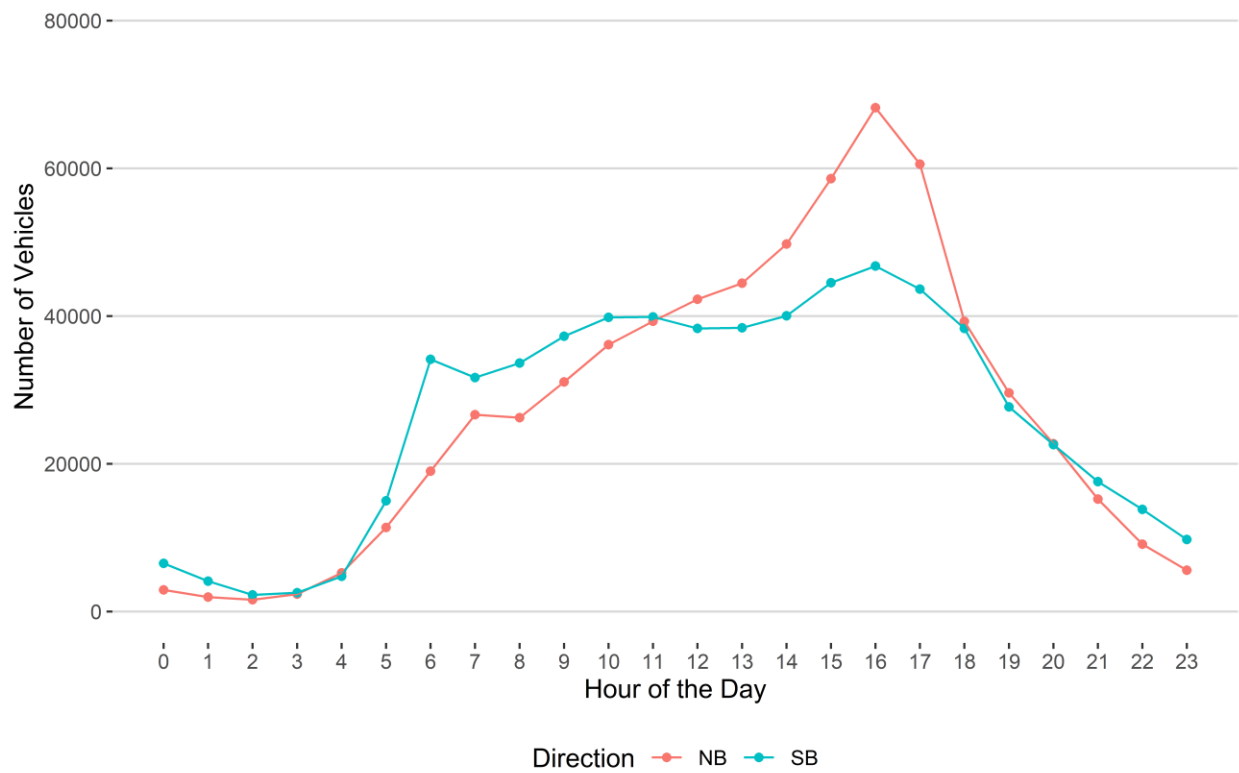


Figure 5 - Heavy Commercial Vehicles
vs. Hour of the Day

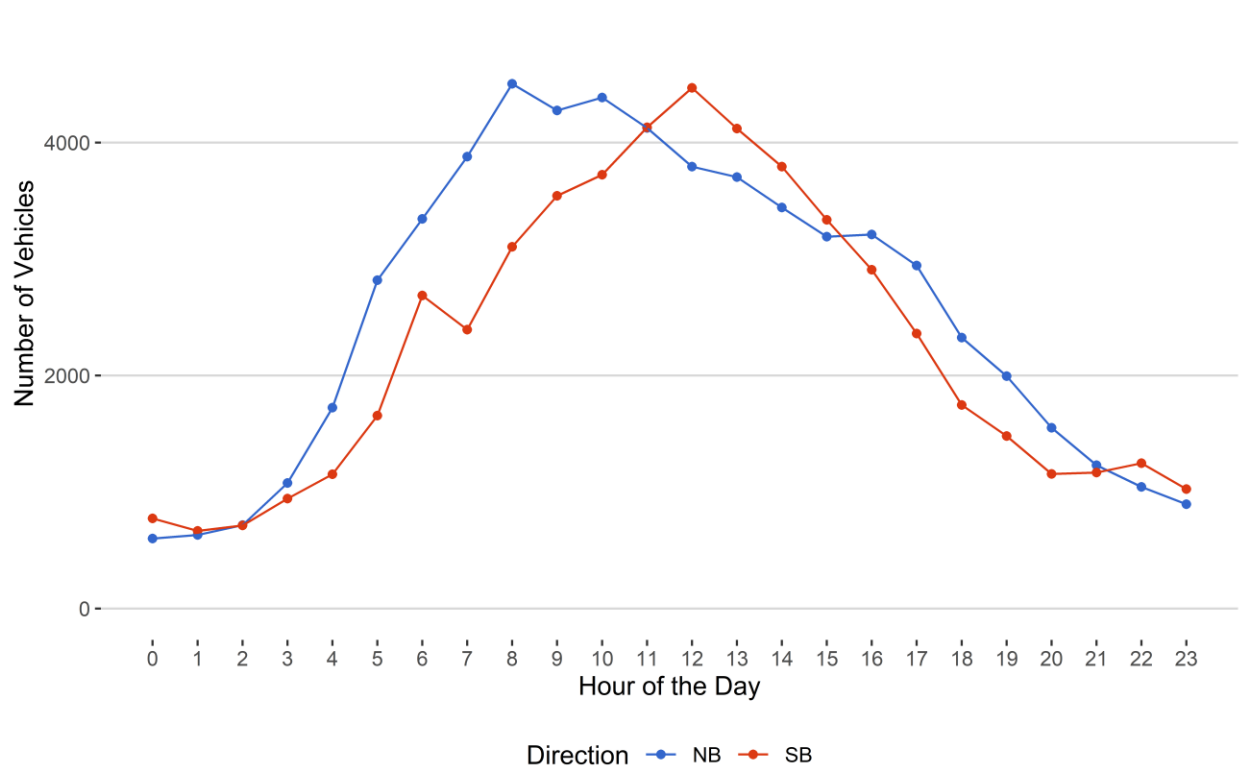


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

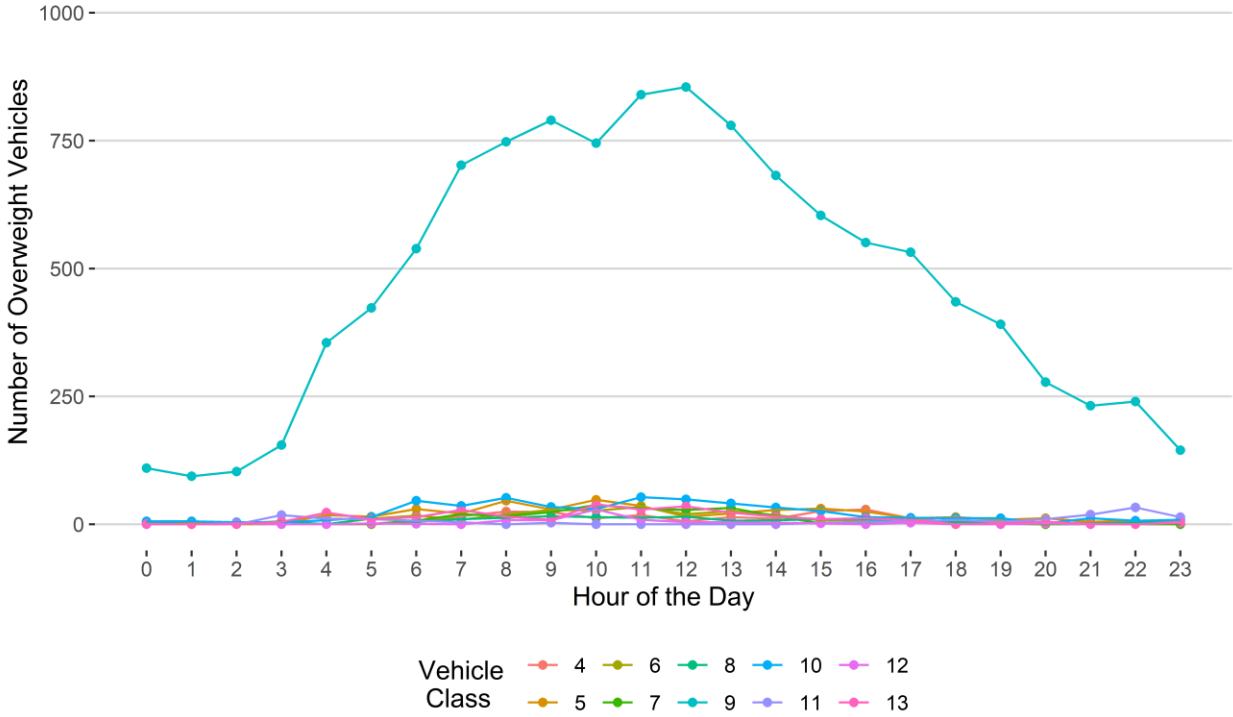


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

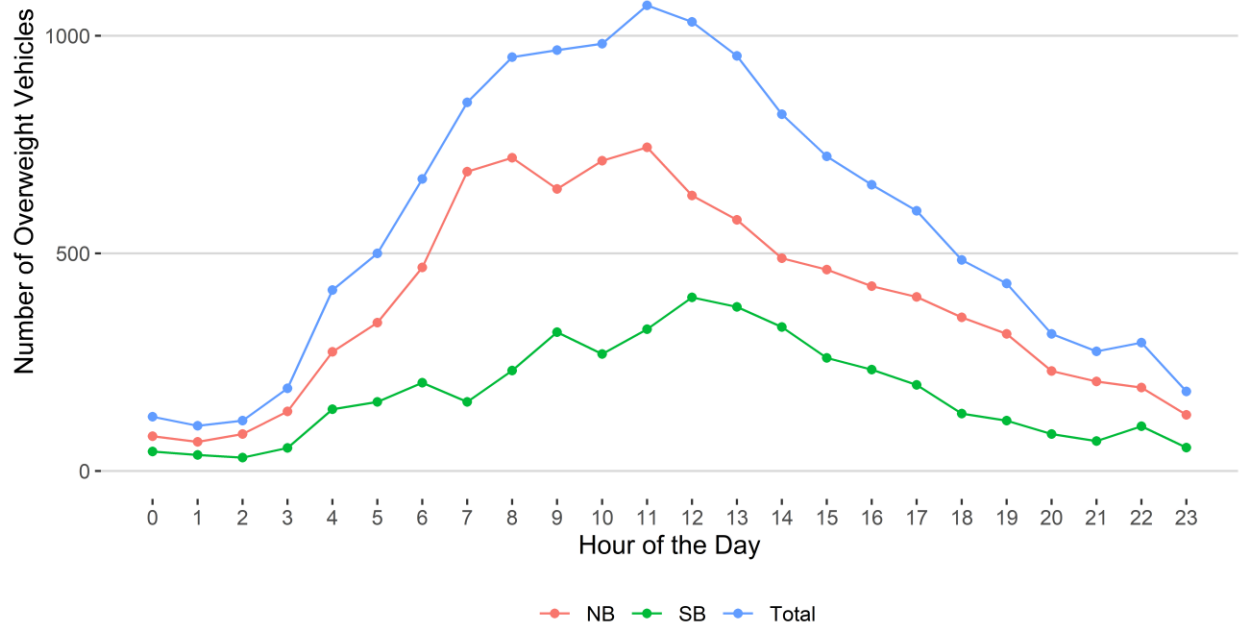
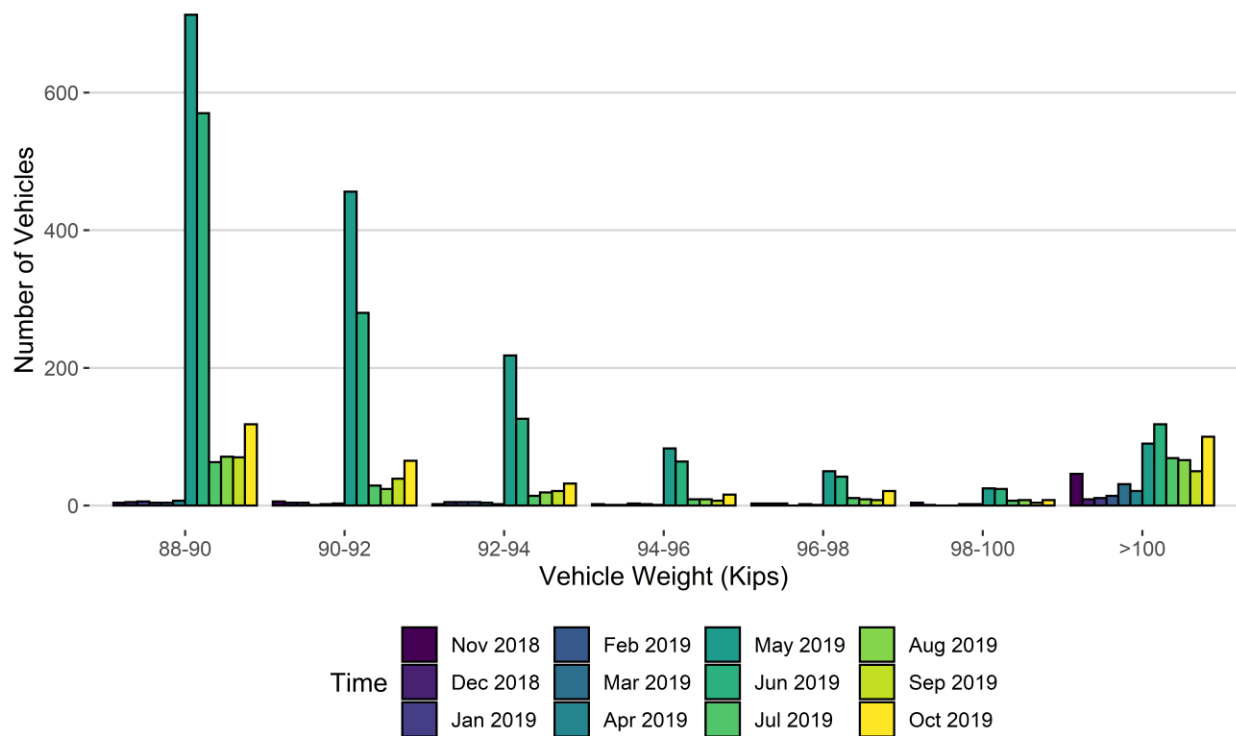
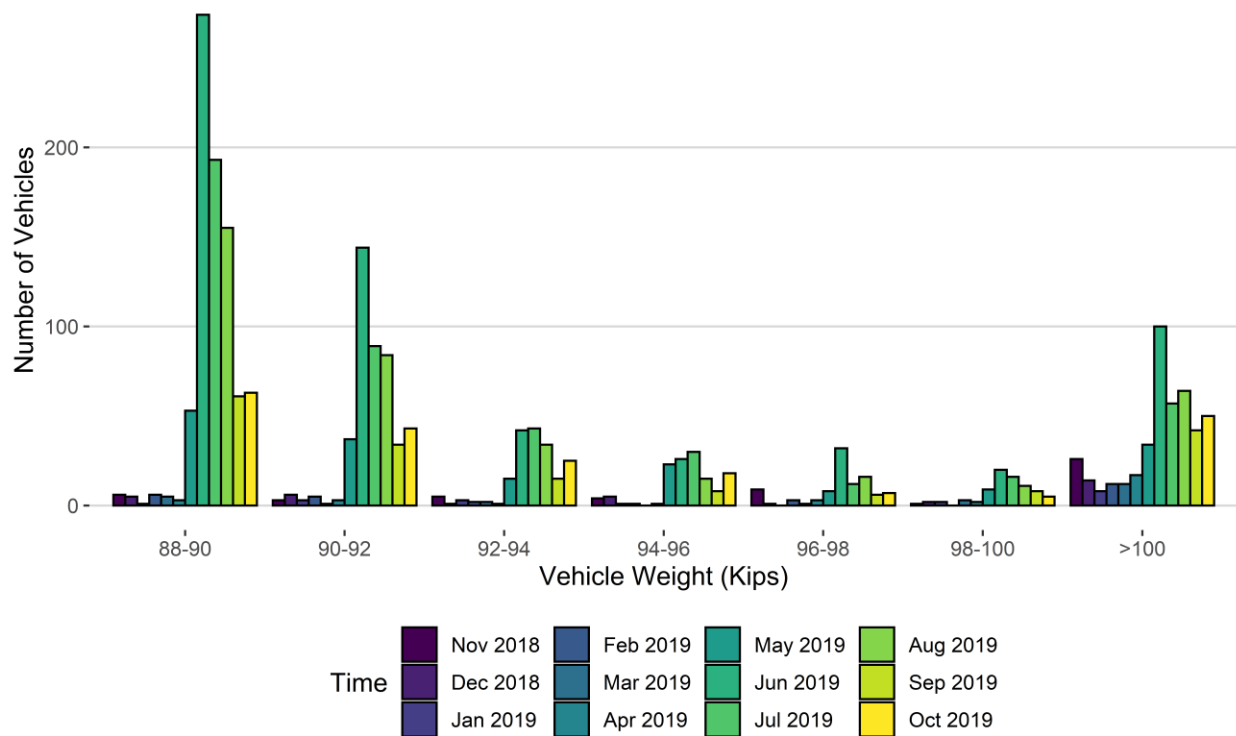


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019
88-90	4	5	6	4	4	7	713	570	63	71	70	118
90-92	6	4	4	1	2	3	456	280	29	24	39	65
92-94	2	5	5	5	4	2	218	126	14	19	21	32
94-96	2	1	1	3	2	1	83	64	9	9	7	16
96-98	3	3	3	0	2	1	50	42	11	9	8	21
98-100	4	1	0	0	2	2	25	24	7	8	4	8
>100	46	9	11	14	31	21	90	118	69	66	50	100
Total	67	28	30	27	47	37	1635	1224	202	206	199	360

Figure 8 - Histogram of SB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019
88-90	6	5	1	6	5	3	53	274	193	155	61	63
90-92	3	6	3	5	1	3	37	144	89	84	34	43
92-94	5	1	3	2	2	1	15	42	43	34	15	25
94-96	4	5	1	1	0	1	23	26	30	15	8	18
96-98	9	1	0	3	1	3	8	32	12	16	6	7
98-100	1	2	2	0	3	2	9	20	16	11	8	5
>100	26	14	8	12	12	17	34	100	57	64	42	50
Total	54	34	18	29	24	30	179	638	440	379	174	211

Figure 8 - Class 9's and 10's by Direction
vs Gross Vehicle Weight

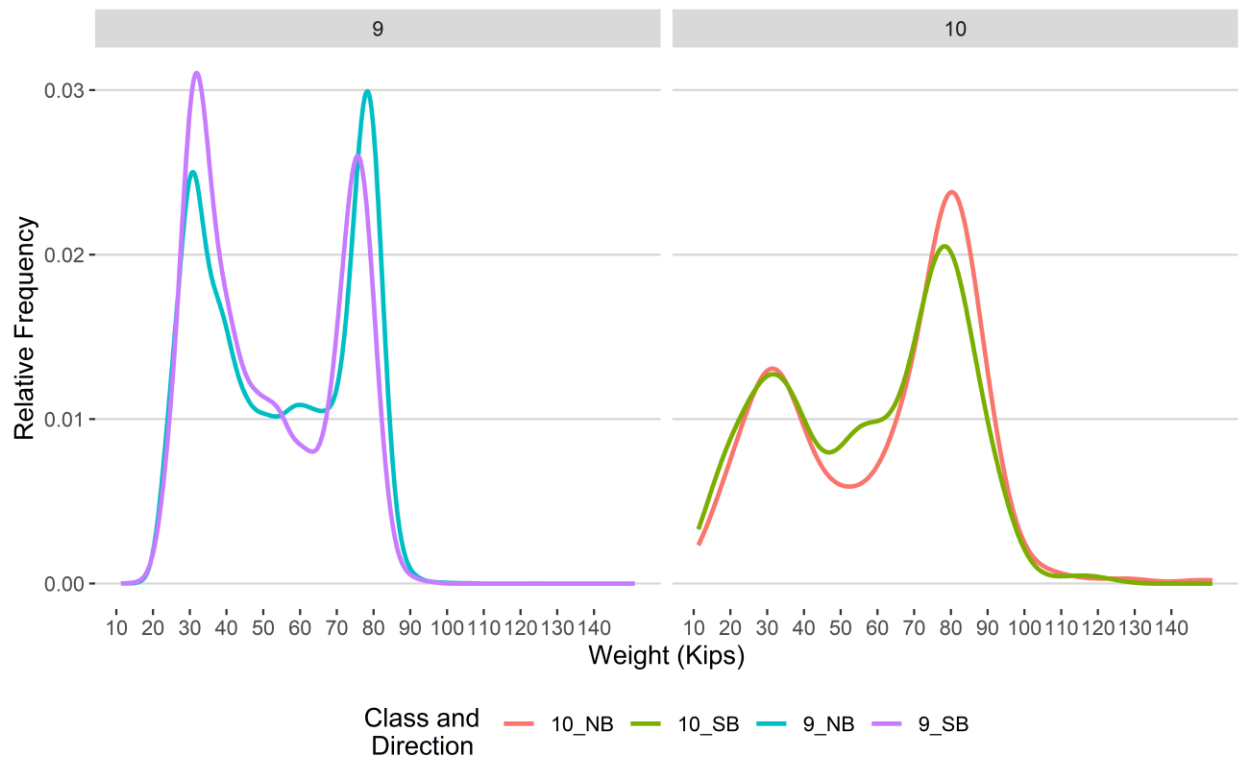


Figure 9 - Freight Percentage
by Direction and Class

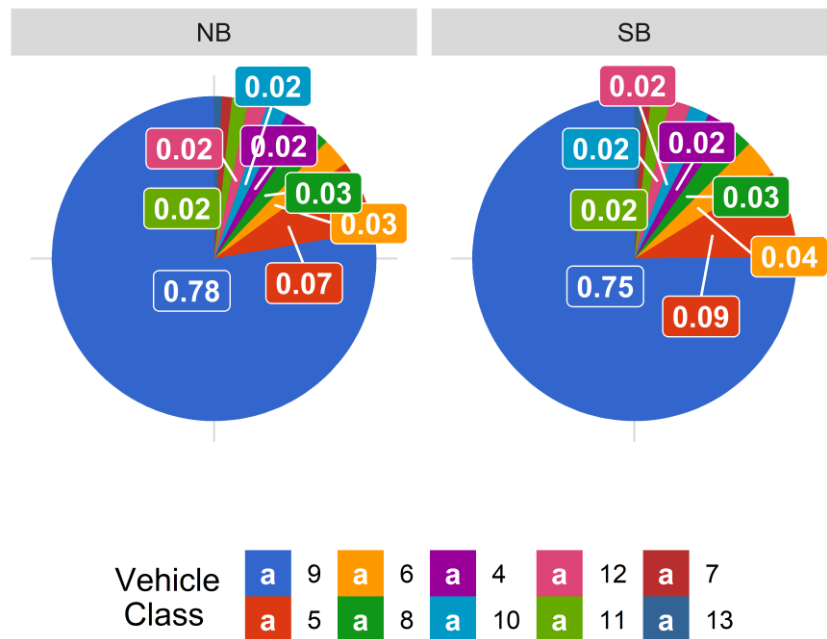


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

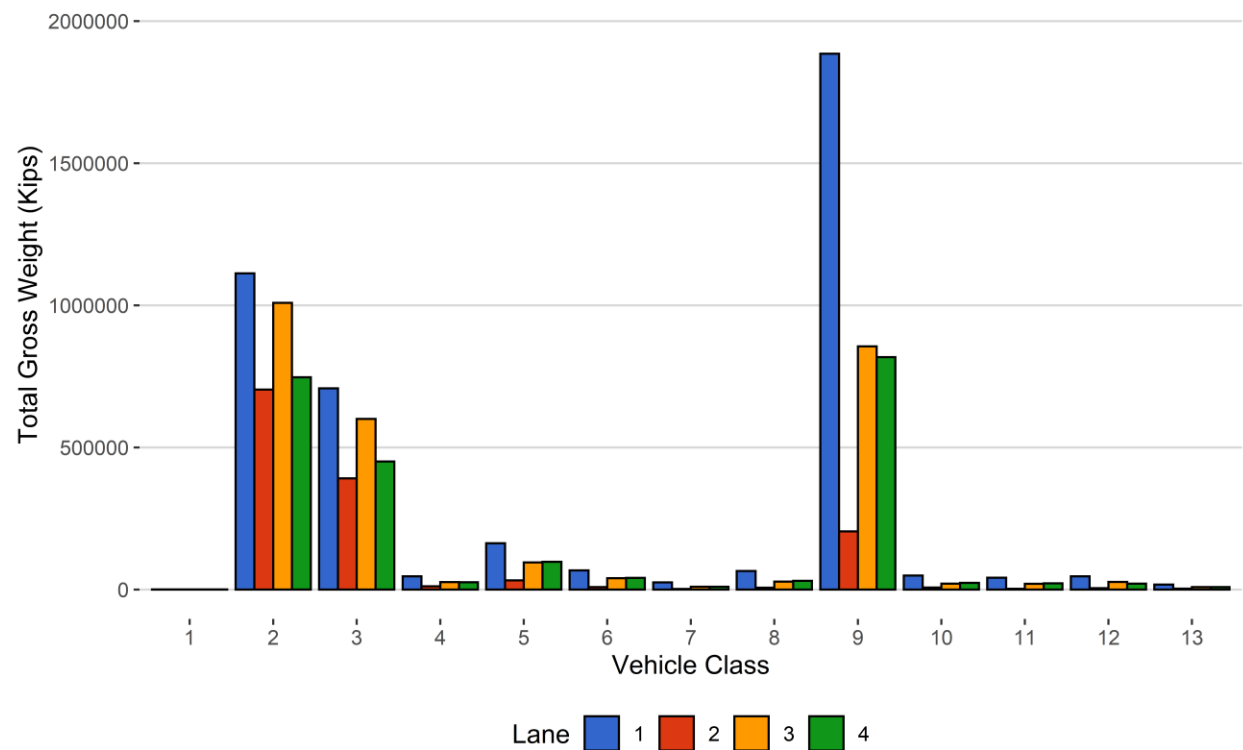


Figure 11 - Total Gross Vehicle Weight t

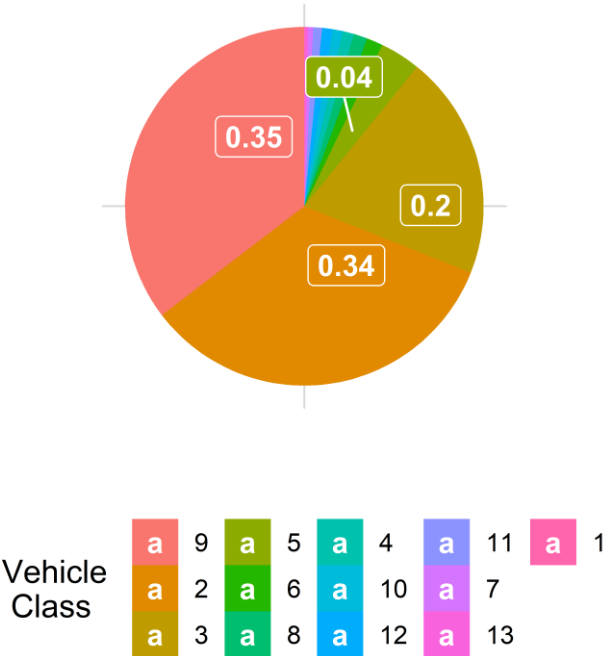


Figure 12 - Total ESALs by Class and Lane

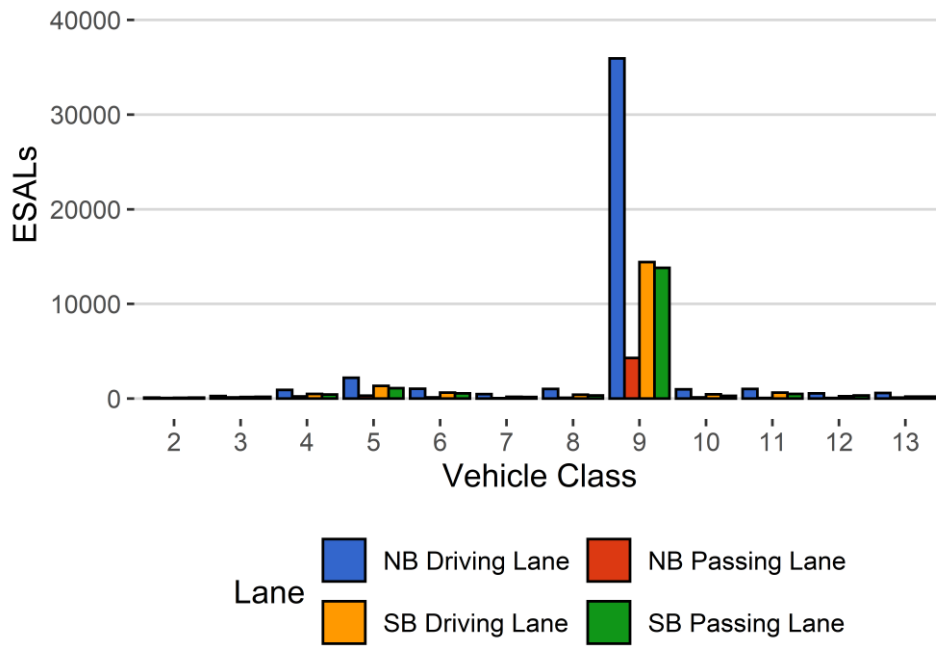


Figure 13 - ESALs by Class

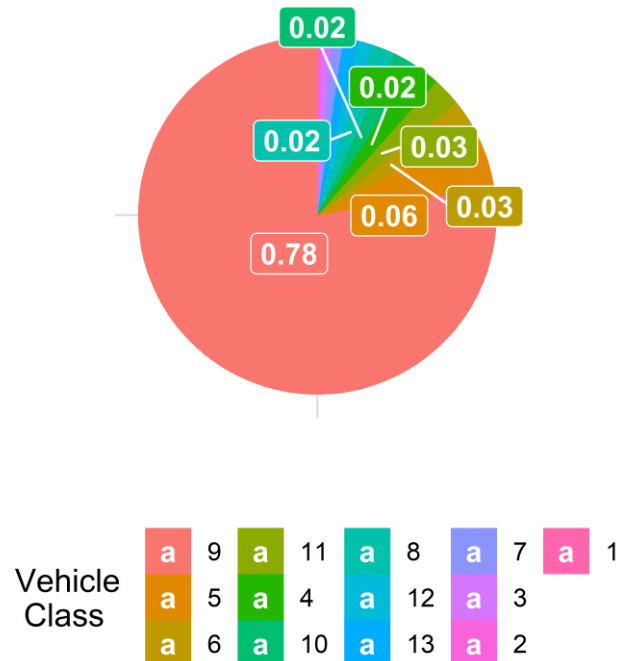


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 3 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 4 (kips)</i>	<i>Front Axle +/- 9%</i>
July 2019	10.23	0.00	11.64	0.00	11.83	0.00	11.75	0.00
August 2019	10.38	1.48	11.65	0.04	11.77	-0.52	11.67	-0.68
September 2019	10.61	3.69	11.49	-1.31	11.19	-5.43	11.53	-1.89
October 2019	10.60	3.63	11.37	-2.31	10.92	-7.71	11.36	-3.28

Table 2 Vehicle Classification Data

<i>Vehicle Class</i>	<i>Monthly Average Daily Volume</i>	<i>Monthly Total Volume</i>	<i>Monthly Total Volume Percentage</i>	<i>Monthly Total Overweight Vehicles</i>	<i>Monthly Total Overweight Percentage</i>
1	4	127	0	0	0
2	21650	671156	66.2	0	0
3	8366	259352	25.6	0	0
4	80	2465	0.2	224	1.6
5	608	18850	1.9	428	3.1
6	127	3941	0.4	243	1.8
7	18	552	0.1	227	1.7
8	100	3115	0.3	166	1.2
9	1653	51242	5.1	11329	82.9
10	39	1203	0.1	523	3.8
11	34	1065	0.1	156	1.1
12	39	1203	0.1	81	0.6
13	9	280	0	287	2.1
TOTAL	32727	1014552	100	13664	100

Table 3 Top 10 Gross Vehicle Weight, Class 9 and 10

<i>Date</i>	<i>Day of Week</i>	<i>Time</i>	<i>Vehicle Class</i>	<i>Direction</i>	<i>Lane</i>	<i>GVW (lbs)</i>
2019-10-15	Tuesday	02:16:52	9	NB	1	153.05
2019-10-25	Friday	09:25:31	10	NB	1	151.14
2019-10-20	Sunday	08:35:11	10	NB	1	147.5
2019-10-26	Saturday	08:22:40	10	NB	1	146.74
2019-10-18	Friday	01:49:36	9	NB	1	133.15
2019-10-25	Friday	03:22:46	9	NB	1	131.86
2019-10-22	Tuesday	08:31:22	10	NB	1	129.95
2019-10-11	Friday	11:04:12	10	NB	1	129.65
2019-10-11	Friday	11:04:12	10	NB	1	129.65
2019-10-01	Tuesday	03:01:14	9	NB	1	124.2

Table 4 Freight Summary

<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	NB	15	1755	171	9.7	55536	2202	15888
5	NB	8	13171	1139	8.6	186913	8406	45329
6	NB	19	2678	717	26.8	63810	12008	13275
7	NB	11.5	431	3	0.7	27230	31	11154
8	NB	31	2339	1348	57.6	39285	32009	4282
9	NB	33	38296	8165	21.3	1856487	233597	431082
10	NB	33.5	907	194	21.4	50968	5002	13541
11	NB	36.5	775	38	4.9	42977	1255	8038
12	NB	36.5	875	78	8.9	48142	2765	9526
13	NB	31.5	198	0	0	20356	0	7059
TOTAL	****	****	61425	11853	****	2391704	****	559175
<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	SB	15	1645	205	12.5	48668	2672	13534
5	SB	8	12827	1323	10.3	183553	9609	45761
6	SB	19	2758	516	18.7	72015	8623	14708
7	SB	11.5	331	0	0	19339	0	7766
8	SB	31	1957	1108	56.6	32453	26018	3067
9	SB	33	32379	7463	23	1456706	216566	317239
10	SB	33.5	752	165	21.9	39837	4018	10086
11	SB	36.5	694	48	6.9	39895	1561	8158
12	SB	36.5	784	34	4.3	45833	1191	9229
13	SB	31.5	188	0	0	16722	0	5400
TOTAL	****	****	54315	10862	****	1955021	****	434949
GRAND TOTAL	****	****	115740	22715	314	4346726	567533	994124

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>NB Driving Lane</i>	<i>NB Passing Lane</i>	<i>SB Passing Lane</i>	<i>SB Driving Lane</i>	<i>Total</i>	<i>Percentage</i>
1	59	49	65	38	212	0
2	1112489	703256	1008721	747113	3571579	33.6
3	707847	391178	600271	450208	2149505	20.2
4	46530	11207	25924	25416	109077	1
5	162994	32325	95475	97687	388481	3.7
6	67127	8691	39724	40914	156455	1.5
7	25130	2131	9745	9594	46600	0.4
8	64864	6431	27739	30733	129767	1.2
9	1885316	204768	855508	817764	3763356	35.4
10	48944	7026	20489	23366	99825	0.9
11	41521	2711	19976	21481	85689	0.8
12	46298	4610	26594	20430	97931	0.9
13	17230	3126	8267	8455	37078	0.3
TOTAL	4226350	1377508	2738499	2293198	10635555	100
GVW/LANE	39.74	12.95	25.75	21.56	100	0

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>NB Driving Lane</i>	<i>NB Passing Lane</i>	<i>SB Passing Lane</i>	<i>SB Driving Lane</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0	0	0.0057
2	116	78	106	85	385	0.44	8e-04
3	279	131	197	166	773	0.88	0.0043
4	915	238	445	495	2093	2.37	1.23
5	2200	308	1113	1342	4962	5.62	0.38
6	1037	139	566	628	2369	2.68	0.87
7	485	57	168	196	906	1.03	2.37
8	1021	97	333	409	1860	2.11	0.87
9	35926	4296	13820	14411	68453	77.56	1.94
10	989	136	293	456	1874	2.12	2.25
11	1026	77	490	645	2237	2.53	3.03
12	564	77	325	262	1228	1.39	1.48
13	590	100	209	218	1118	1.27	5.64
TOTAL	45146	5733	18065	19314	88258	100	20
ESALS/LANE	51.2	6.5	20.5	21.9	100	-	-

Table 7 Site Summary: Volume and Vehicle Class

<i>Month</i>	<i>Total Volume</i>	<i>Monthly ADT</i>	<i>Monthly HCAD T</i>	<i>Passenger Vehicles</i>	<i>Passenger Vehicles %</i>	<i>Heavy Commercial Vehicles</i>	<i>Heavy Commercial Vehicles %</i>	<i>Heavy Commercial Vehicles in Driving Lane %</i>	<i>Heavy Commercial Vehicles in Passing Lane %</i>
Nov 2018	807078	31042	2150	742577	92	64501	8	88.3	11.7
Dec 2018	864651	28822	2035	801570	92.7	63081.4	7.3	89.2	10.8
Jan 2019	786295	25364	2059	722455	91.9	63839.9	8.1	88.7	11.3
Feb 2019	682508	24375	2079	624284	91.5	58224	8.5	82.2	17.8
Mar 2019	904406	29174	2268	834104	92.2	70302.3	7.8	88.7	11.3
Apr 2019	922175	30739	2481	847749	91.9	74425.7	8.1	88.3	11.7
May 2019	1039153	33329	2670	956381	92	82771.9	8	87.5	12.5
Jun 2019	1022960	34099	2622	944302	92.3	78658.4	7.7	86.8	13.2
Jul 2019	1058475	34221	2702	974717	92.1	83757.7	7.9	87.2	12.8
Aug 2019	1096548	35208	2723	1012139	92.3	84409.1	7.7	88	12
Sep 2019	978335	32323	2587	900716	92.1	77619.2	7.9	70.3	29.7
Oct 2019	1014552	32808	2707	930636	91.7	83916.5	8.3	69.5	30.5
TOTAL	11177136	-	-	10291630	-	885507	-	-	-
AVERAGE	931428	30959	2424	857636	92	73792	8	85	15

###ESALs

<i>Month</i>	<i>ESALS NB Passing Lane</i>	<i>ESALS NB Driving Lane</i>	<i>ESALS SB Driving Lane</i>	<i>ESALS SB Passing Lane</i>	<i>Total ESALS</i>	<i>Driving Lane ESALS %</i>	<i>Passing Lane ESALS %</i>	<i>Pavement Life Decrease Months</i>
Nov 2018	16547	2620	1352	14453	34973	89	11	1.2
Dec 2018	12208	2206	1054	12749	28217	88	12	0.2
Jan 2019	10858	2006	1055	11960	25880	88	12	0.3
Feb 2019	8685	2828	1545	10833	23891	82	18	0.3
Mar 2019	12211	2429	1320	13607	29567	87	13	0.1

Apr 2019	13454	2771	1525	14186	31936	87	13	0
May 2019	32259	4042	3006	23513	62819	89	11	21.3
Jun 2019	53625	10086	7472	58409	129592	86	14	3.4
Jul 2019	25138	4916	4146	32194	66394	86	14	4.4
Aug 2019	27967	4501	3840	31466	67774	88	12	3.9
Sep 2019	28842	3734	12568	14341	59485	73	27	2.5
Oct 2019	45318	5748	18129	19409	88604	73	27	3.2
TOTAL	287114	47886	57013	257120	649132	-	-	-
AVERAGE	23926	3990	4751	21427	54094	85	15	3

###Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Passing Lane</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Passing Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Nov 18	2335826	846388	669420	2308649	6160283
Dec 18	2086264	770010	604432	2166104	5626811
Jan 19	1876590	646522	520347	1994371	5037829
Feb 19	1423377	652606	530116	1737913	4344012
Mar 19	2086856	798781	620139	2233229	5739005
Apr 19	2203311	844134	673418	2294631	6015495
May 19	2887575	1038509	896554	2762671	7585308
Jun 19	5370351	2138820	1938350	5817580	15265101
Jul 19	2756663	1092970	1018131	3103868	7971633
Aug 19	2918571	1091245	1004179	3150967	8164962
Sep 19	2762888	929295	1822629	1612644	7127456
Oct 19	4231861	1378634	2741559	2296074	10648128
TOTAL	32940134	12227913	13039274	31478701	89686023
AVERAGE	2745011	1018993	1086606	2623225	7473835

###Overweight Vehicles

<i>Month</i>	<i>Total Number of Overweight Vehicles</i>	<i>Overweight / Total Volume</i>	<i>Overweight / Heavy Commercial Volume</i>	<i>Number Over 88,000 lbs</i>	<i>Number Over 98,000 lbs</i>
Nov 2018	1176	0.1	1.6	125	77
Dec 2018	728	0.1	1.1	66	27
Jan 2019	575	0.1	0.9	48	21
Feb 2019	794	0.1	1.4	56	26
Mar 2019	591	0.1	0.9	71	48
Apr 2019	563	0.1	0.8	70	42
May 2019	9712	1	11.9	1831	162
Jun 2019	22320	1.1	14.5	1866	262
Jul 2019	11264	1.1	13.7	645	150

Aug 2019	11662	1.1	14.1	585	149
Sep 2019	10051	1.1	13.4	382	112
Oct 2019	13708	1	11.8	574	166
TOTAL	83144	-	-	6319	1242
AVERAGE	6928.7	0.6	7.2	526.6	103.5

###Freight

<i>Month</i>	<i>NB Freight Tons</i>	<i>SB Freight Tons</i>	<i>Total Freight</i>	<i>NB Freight %</i>	<i>SB Freight %</i>
Nov 2018	261150	229123	490273	53.3	46.7
Dec 2018	207108	197689	404797	51.2	48.8
Jan 2019	191437	189886	381323	50.2	49.8
Feb 2019	161646	180700	342346	47.2	52.8
Mar 2019	217306	218688	435994	49.8	50.2
Apr 2019	239111	230147	469258	51	49
May 2019	377156	315573	692729	54.4	45.6
Jun 2019	693719	700129	1393849	49.8	50.2
Jul 2019	346328	382396	728724	47.5	52.5
Aug 2019	363149	374052	737201	49.3	50.7
Sep 2019	356729	300943	657672	54.2	45.8
Oct 2019	559175	434949	994124	56.2	43.8
TOTAL	3974014	3754275	7728289	-	-
AVERAGE	331167.9	312856.2	644024.1	51.2	48.8